

EOS

Circular Polarization Experiment

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Part 1 - Background



- Dave Arnold has said at several recent ILRS meetings that there may be differences in target signatures due to the state of polarization of the beam incident on the target.
- Effects only on uncoated retros – e.g. Lageos 1 & 2 and ETS 8.
- For **LINEAR** polarization on LAGEOS, cross section varies between 10 and 21×10^6 m², and range correction by 3.2 mm, depending upon angle between polarization and velocity aberration vectors. (Arnold, private comm., 15 Sep 2007)
- For **CIRCULAR** polarization, there is little such variation.
- Are differences between linear and circular polarization of incident laser beam measurable in practice?

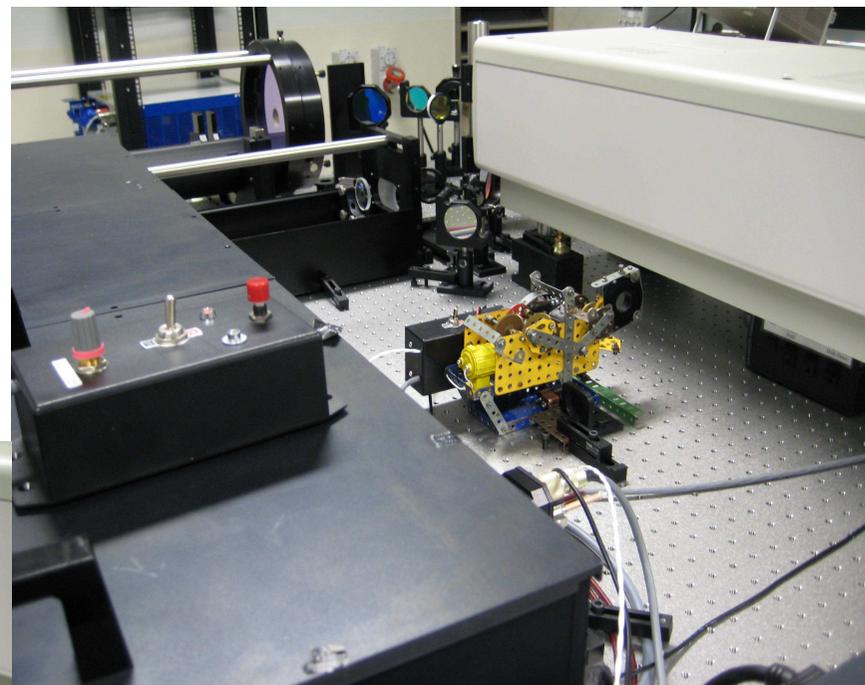
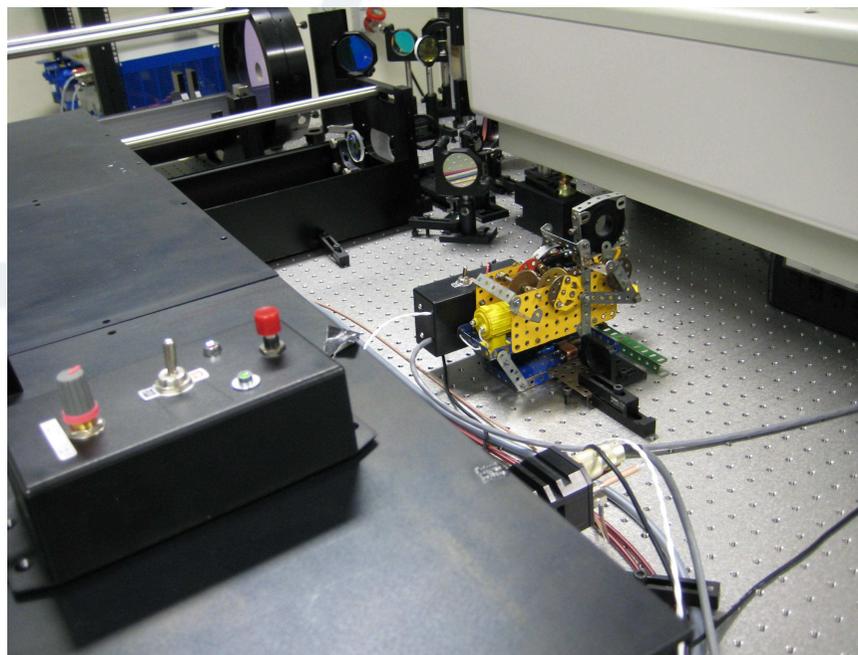
Experimental Design



- Transmit with circular and linear polarized laser beam to Lageos 1 & 2, by insertion of quarter-wave plate (QWP).
- Within any pass, alternate between polarizations, keeping the system and environment the same (as far as possible). We tried to keep return rate constant.
- Select normal point periods (2 min on Lageos) for alternative polarizations.
- LAGEOS-1 spin period is (reputedly) 6000 secs so orientation changes by $\sim 7^\circ$ within 1 NP (ie \sim constant).
- LAGEOS-2 is 360 secs so changes by $\sim 120^\circ$, which gives significant averaging.
- Choose clear nights so return rate $> 170 / \text{NP}$.

Experiment Setup

QWP Inserter on Laser Table. Laser Fire inhibited while inserter is moving.

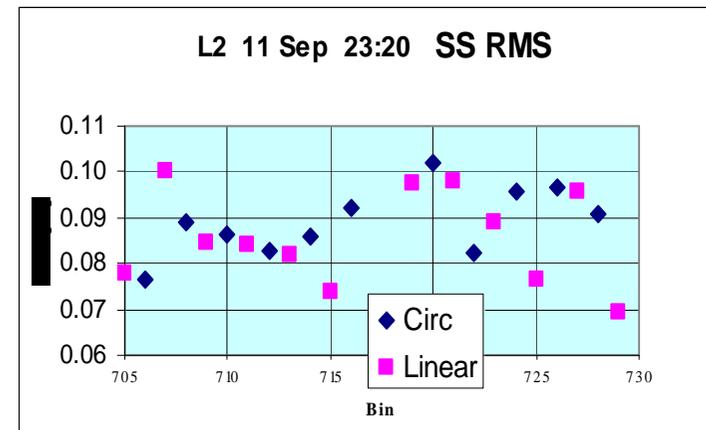
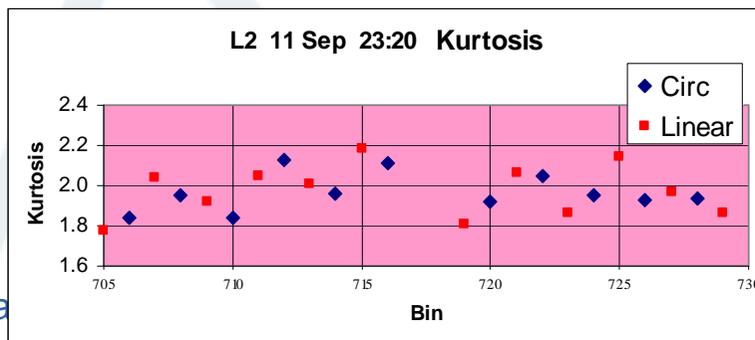
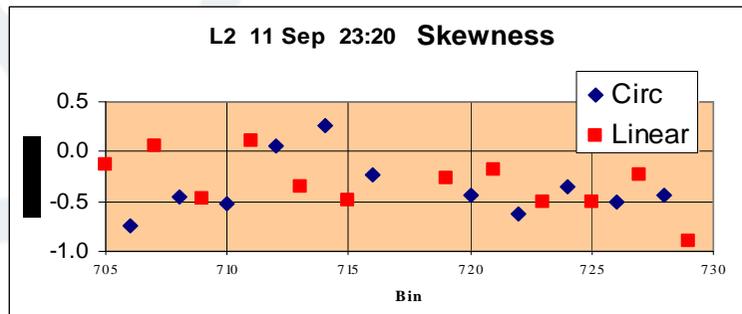
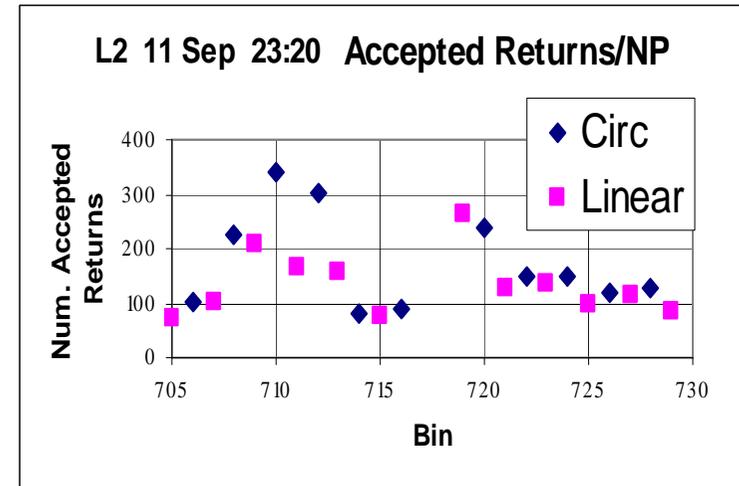


27 May 2004

Results



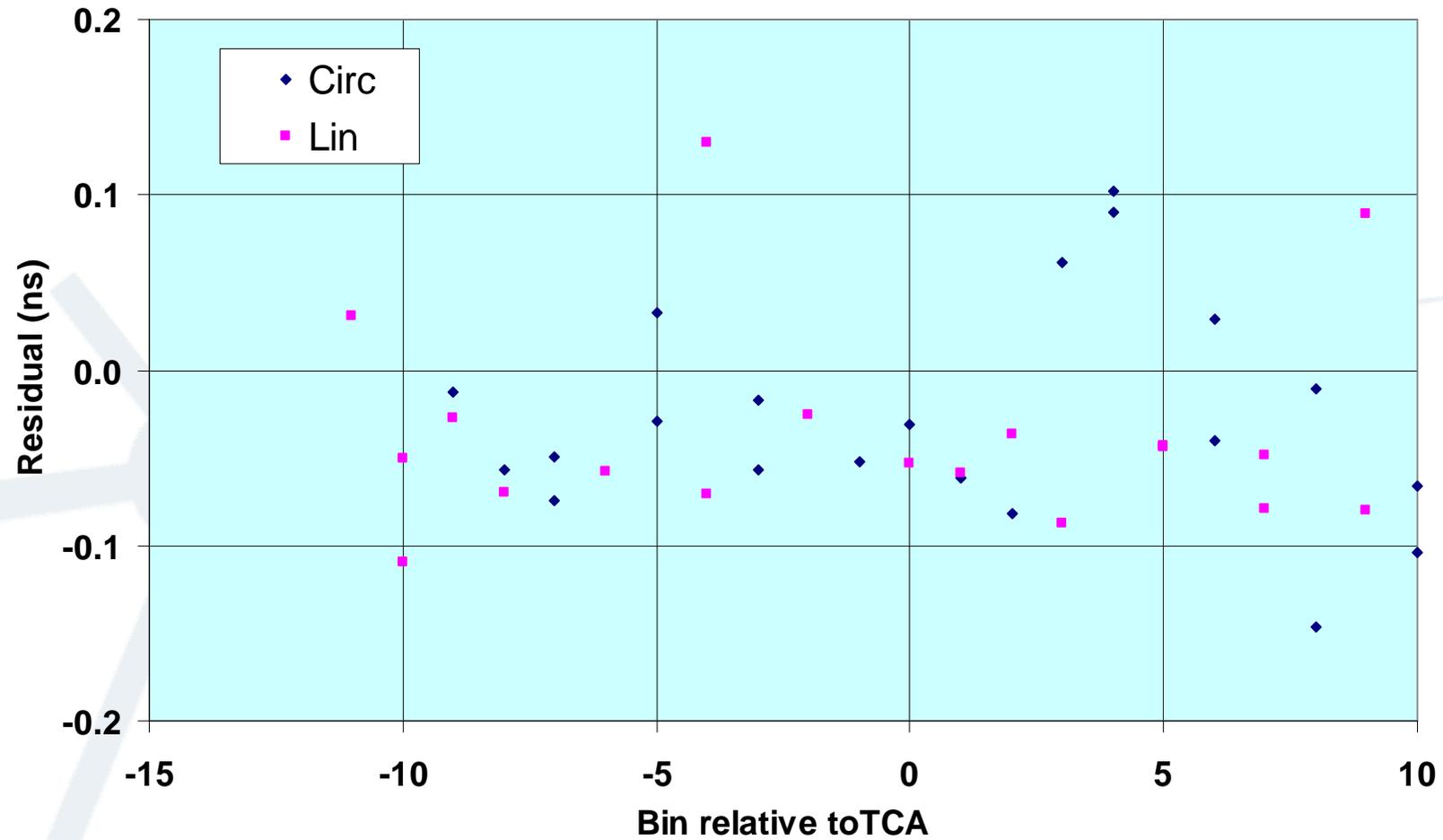
- Results from 2 Lageos 1 and 2 Lageos 2 passes, average 172 returns per normal point.
- Typical Single Shot RMS 90 ps (13.5 mm) hence NP RMS 1 mm.
- No obvious differences in single-shot RMS, skewness or kurtosis.



Results



Both LAGEOS-1 Passes: Combined NP Residuals

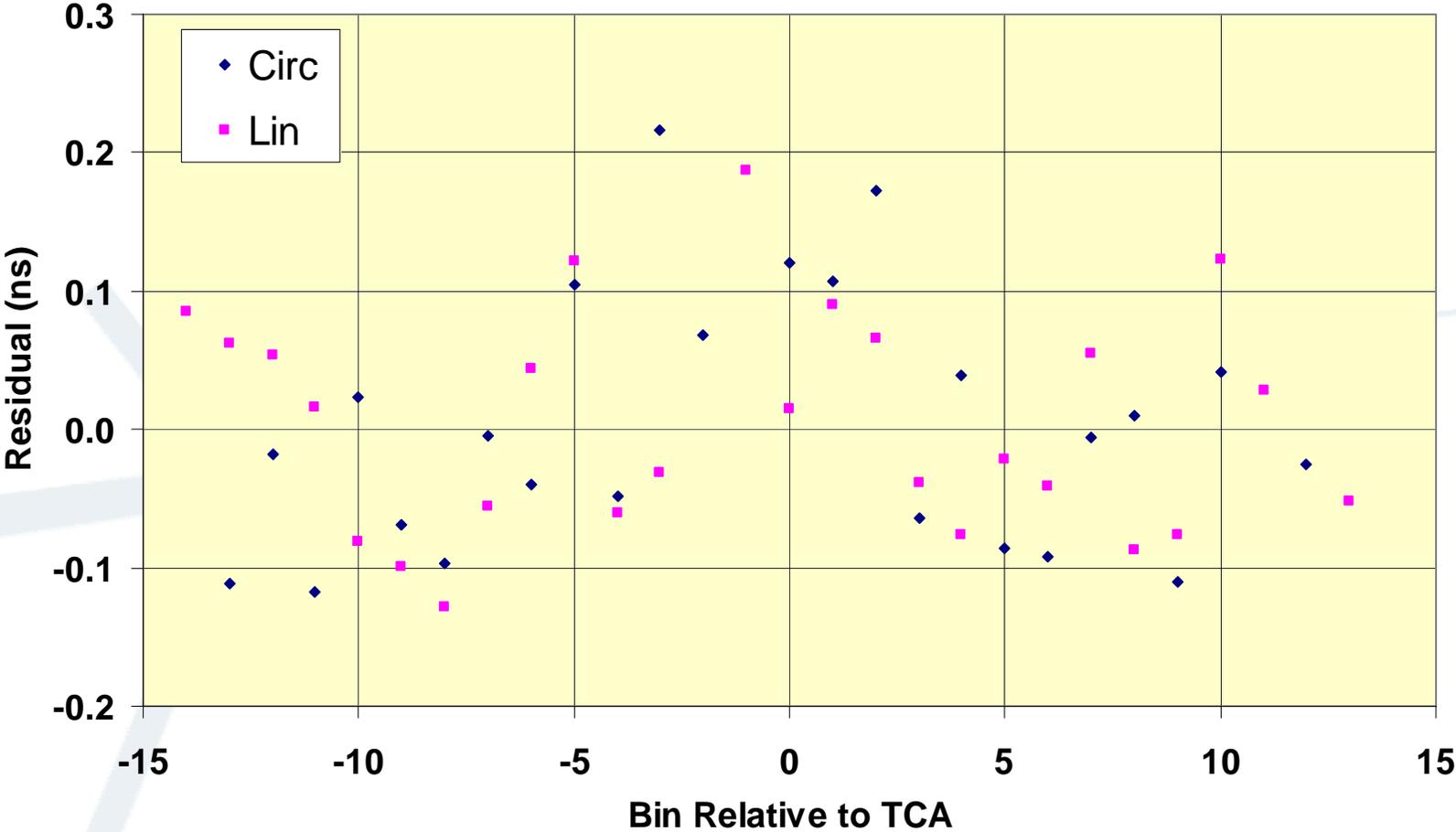


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Results



Both LAGEOS-2 Passes: Combined NP Residuals



Conclusions



- No differences observed in rms, skewness and kurtosis, i.e. in the shapes of the distributions.
- Combined residual graphs show tantalizing patterns.
- This experiment was simply a proof of technique.
- Results are preliminary – more experiments needed:
 - Maximize return rates, instead of equalizing;
 - 1 minute ‘bins’ on LAG-1, 5 minutes on LAG-2;
 - Graph against angle between polarization and velocity aberration vectors (when we can calculate them.....).
- **QUESTIONNAIRE: What stations transmit in circular polarization ?**